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REVIEW OF THE LATEST DEVELOPMENTS RELATING TO POLICIES AND
MANAGEMENT OF NATIONAL MAPPING AND CHARTING PROGRAMMES:

AUTOMATIC CARTOGRAPHY: DEVELOPMENT AND APPLICATION OF DIGITAL
CARTOGRAPHIC DATABASES, INCLUDING DIGITAL TERRAIN MODELLING

Development of the Topographic Data System in Finland

Paper submitted by Finland**

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Introduction

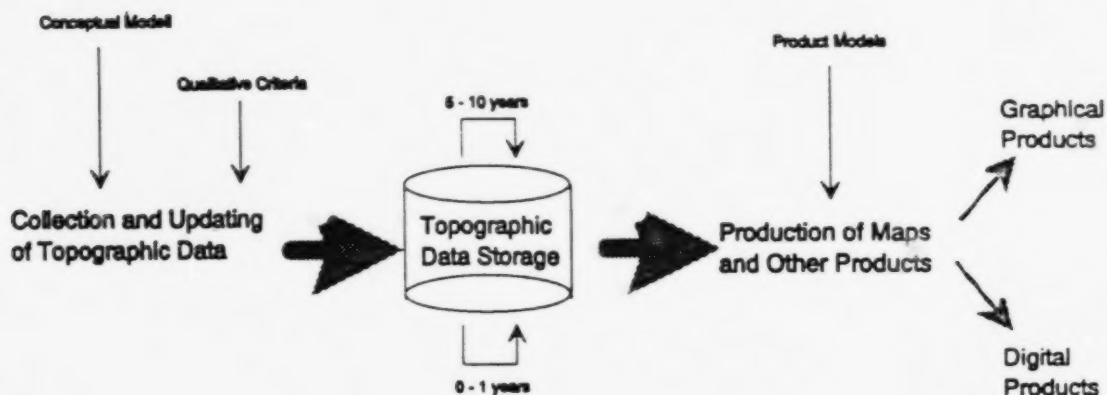
Key mapping assignments of recent decades have included the measurement of national control points and the basic mapping of Finland. Since the first round of basic mapping was completed in the 1970s, the Basic Map Series has been continually updated. Most of this work has been carried out using long-established methods, although computers have been used since the 1970s to automate certain stages of production, such as fair drawing.

Since the late '80s the National Land Survey has comprehensively upgraded its methods of topographic map production. In 1987 and 1988 planning was carried out for a new, more generalized 1:50,000 topographic map, which has been under computerized production since 1989. In 1991 a project was launched to upgrade methods of producing the 1:5,000 - 1:20,000 Basic Map, the results of which have been put into production in 1992.

The aim in modernizing the production of topographic maps is to create a topographic data system which will enhance the flexibility of the present mass production-based system. In addition to producing conventional printed and copied maps, the topographic data system creates opportunities for a whole new range of products carefully tailored to the customers' needs.

Topographic data system

The system is designed for gathering and updating topographic data and for producing maps and other material.



The collection and updating of topographic data

The collection and updating of topographic data revolves around a network of permanent control points; about 1,000 new triangulation points and 1,200 elevation bench marks are measured yearly.

A new system has been adopted for surveying horizontal control points: the Global Positioning System (GPS). All data are now processed automatically, from the reception of satellite data to transferral of the measured coordinates to other systems.

Automated levelling equipment and topographic data recorders have revolutionized the process of measuring elevation bench marks.

According to current production plans for topographic maps, aerially photographed terrain annually accounts for an area of about 20,000 km² at a reproduction scale of 1:16,000, and about 30,000 km² at a scale of 1:31,000. Auxiliary control points for stereoplotters are obtained using photogrammetric control densification, where exact coordinates are calculated for the signalled cadastral boundary marks.

Topographic data on roads, buildings, fields, bodies of water and powerlines are obtained using a stereoplotter. With some terrain, stereoplotters are also used in the plotting of contours to achieve a higher level of accuracy. Supplementary topographic data obtained from existing maps or copied from registers or other indexes are then digitized. These data are topologically and cartographically integrated with those obtained using the stereoplotter.

All topographic data in graphic-mode Basic Maps can be digitized, provided that the control points and mapping procedures conform to the current quality standards required of topographic data.

Terrain which cannot be interpreted with the aid of aerial photographs or other sources is surveyed on site.

The procedure for collecting and updating topographic data complies with a set of guidelines drawn up on the basis of the conceptual model and its qualitative criteria. The conceptual model defines the different features of terrain to be included in the topographic database, while the qualitative criteria define the standards of topographic data gathered and updated for those features of terrain. The guidelines then determine how the information on those classes of terrain is to be interpreted and how it is to be collected from different sources.

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Information on traffic networks, buildings and powerlines is updated every year or more. Information from other authorities is taken into account as extensively as possible when these entries are updated. High altitude photography is used as a further source of reference. Entries thus revised are kept up-to-date, although their level of geographical precision is inferior to that of terrain which has been stereoplotted. For optimum accuracy, regional mapping based on aerial photography is carried out every 5-10 years.

Over the next ten years, the aim is to compile all topographical data complying with the conceptual models and qualitative criteria into the topographical database. In effect, this means that 40,000 km² will be mapped each year. Certain sites, such as roads, water areas, fields and contours, have been digitized on an expedited schedule. This information will be copied from the 1:20,000 Basic Map of Finland and digitized in full by the end of 1993.

The task of collecting and updating topographic data is divided between the National Land Survey's 11 mapping and data service offices.

Topographic database

The National Land Survey's topographic database is a national, topologically and cartographically integrated, up-to-date, topographical index that is the most geographically accurate of its kind. The database forms a core part of Finland's geographical information system.

The following data are recorded in the topographic database:

- traffic networks;
- buildings;
- powerlines;
- terrain features;
- bodies of water;
- elevation;
- special regulations;
- conservation sites;
- administrative boundaries;
- cadastral structure; and
- control points.

The conceptual model defines the topographic data to be recorded for the site in question. These include the site's class of terrain, geometrical depiction and level of geographical accuracy, its code for joint access with other data systems and an abridged attributes on its specific characteristics.

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Finland measures 338,000 km² in area. It is estimated that the topographic database will eventually contain 53 gigabytes. The database is currently distributed between the National Land Survey's mapping and data service offices.

Database products

The production of maps and other products is chiefly based on the information collected and updated for the topographic database.

The printed editions of the 1:20,000 Basic Map and the 1:50,000 topographic map are compiled from information in the topographic database using automated, interactive techniques. A map publishing system is used to produce printing films. New cartographic products are brought out in line with technological innovation and customer demand.

Other printed products compiled from information in the database are produced using a range of plotters.

Demand for topographic data in digital format is constantly on the increase. The specific data required by the customer can be singled out from the database. If required, they can then be combined with geographical information produced elsewhere and tailored to suit the customer's needs. A special effort is made to keep the production of digital products as flexible as possible so as to ensure that they meet the customer's needs exactly.

Geometrical data for Finland's roadways are copied from the distributed topographic database into a centralized service database on roadways, which can likewise be used to produce a new range of products. A national roadway database will be set up by the end of 1993.

All graphic-mode 1:20,000 topographic maps are to be converted to numerical raster format by the end of 1993. This quick response to growing demand for digital data also provides an opportunity to augment the product range.

Product specifications are documented in the product models.

Development of the topographic data system

The topographic data system has been developed around established production methods: that of the 1:10,000/1:20,000 Basic Maps and the 1:50,000 topographic maps and the MAAGIS geographical information system created by the National Land Survey of Finland. The objective has been to implement a step-by-step strategy in the development of production structures for topographic maps, whereby a minimal amount of time is spent developing the method before it is brought on stream.

Schedule for the development of the topographic data system:

	1987	1988	1989	1990	1991	1992	1993	1994	1995
Topographic map 1:50,000									
Basic Map 1:5,000-1:20,000									
Intergration of the systems									
Development of database products									

Form and content of the 1:50,000 topographic map was defined in 1987 and 1988. A computerized production method was introduced in 1989-1991. Map production was launched in 1989, and the fine-tuning of the system was carried out while production was under way.

Form and content of the 1:5,000 - 1:20,000 Basic Map was defined in 1991 and 1992. A system was concurrently set up to comprise all stages of production from the collection of topographic data and the compilation of printed editions, right up to the distribution of digital data. The system was integrated in the National Land Survey's decentralized production infrastructure in 1992.

The next step is the interfacing of the two systems (that of the 1:50,000 topographic map and the 1:5000 - 1:20,000 Basic Map) to avoid overlaps in entering the bulk of the information into the database. Maps and digital products are accessed from the topographic database and then further refined.

The system was further improved in 1992 with the introduction of a new map publishing system and a new commercial GIS system used for setting up service databases.

Modernization of the topographic data system is imperative if the National Land Survey is to keep up with continuing advances in information technology and the opportunities its comprehensive use offers. Up-to-date, digital topographic data represent a growing focus of mapping and its product range.

The new topographic data system will hopefully improve the productivity and cost-effectiveness of mapping operations by up to several dozen per cent.
